AP Physics C – Mechanics

Prerequisites

**1.** Satisfactory completion of an honors course application

**2.** Departmental recommendation

**3.** Minimum 85% average upon completion of Physics 1

**4.** Completion of Advanced Math and some form of Calculus takenconcurrently

Academic Standards

The following standards will be addressed in this course:

3.1 – Unifying Themes

3.2 – Inquiry and Design

3.4 – Physical Science, Chemistry, and Physics

3.7 – Technology Devices

3.8 – Science, Technology and Human Endeavors

Texts

*Physics for Scientists and Engineers*, 7th edition, by Serway & Jewett, 2008, Thomson *Physics: Principles and Problems,* Glencoe Science, 2005, McGraw Hill

*Conceptual Physics,* by Paul G. Hewitt, 3rd edition, 1999, Addison Wesley Longman

The AP® Physics C is a national calculus-based course in physics. The syllabus for this course is designed by the College Board. This course is equivalent to the pre-engineering introductory physics course for university students. The emphasis is on the understanding of concepts and skills of basic mechanics, and using the concepts and formulae to solve complex problems. Laboratory work is an integral part of this course.

Course Description

Each day, students will be presented with a question or assignment and will be expected to work in small groups to answer that question. New topics will be introduced in this manner, but questions will also address topics already covered to enhance conceptual understanding. Students will have access to books, the Internet, lab equipment, computer simulations, etc. The teacher will act as a facilitator assisting and guiding students, at all times encouraging carefully articulated responses based on principles of physics.

On a regular basis, students will also work in small groups on context rich problems. Each group will be given a problem and will be expected to work out and present their solution to the class. Throughout the course, examples of “real life” applications of interest to students will be used to challenge them to apply what they have learned; these examples will be used in the daily questions, in the context rich problems, in demos, etc.

Students will refer to the course wikispace to confirm each daily activity and to form an online discussion about the current topics with the instructor as well as the rest of the class. Students will use this site to be able to look up assignments and notes about new material.

Academic Expectations

Students in this honors course will demonstrate ambition towards physical understanding of topics generally studied by scientists and engineers. Each student is expected to take responsibility for their own education by taking time to study and learn independently. Exceptional skills in algebra, trigonometry, problem solving, writing, and communication will all be necessary for success. **Due to the pace and difficulty of the course students are encouraged to avoid any long term or excessive absences.**

Course Evaluation

Your grade will be based on the following:

Exams..................................................................................................................... 40%

Homework.............................................................................................................. 20%

Laboratory.............................................................................................................. 20%

Discussion............................................................................................................... 20%

Laboratory

The lab component of this course is designed to cover concepts via scientific inquiry and use critical thinking skills. Much of the teaching you will do for yourself and for each other. I will provide you with some introduction and background. Then I will assign to you a task, problem, or question (perhaps more than one at a time). You will work individually or in groups, often with hands-on equipment and materials, to complete the task. Often, you will be asked to present your solutions to the class and/or to critique or verify the solutions of others.

There is a 90 minute lab every week. The lab report will be graded on the student’s participation in the actual experiment and the written report. **Students must save all the graded lab reports. They will be required to present** **the lab reports as a proof of having done these labs when they seek credit for** **this course in college.**

**Each lab will require:**

1. The formation of an hypothesis or hypotheses, based on in-class discussion of the presented problem or focus of each experiment
2. Design of (an) experiment(s), also based on in-class discussion, to test the hypothesis or hypotheses
3. Collection of data and observations
4. Calculations using the collected data
5. Conclusions about how well the hypothesis or hypotheses held up based on the experiment
6. Class discussion of variance and error analysis
7. Written report

Course Outline

**Chapter 2 – Motion in One Dimension (September)**

2.1- Position, Velocity, and Speed

2.2- Instantaneous Velocity and Speed

2.3- Analysis Models: The Particle Under Constant Velocity

2.4- Acceleration

2.5- Motion Diagrams

2.6- The Particle Under Constant Acceleration

2.7- Freely Falling Objects

2.8- Kinematic Equations Derived from Calculus

Probeware Lab: How fast is it accelerating?

**Chapter 3 – Vectors (September - October)**

3.1- Coordinate Systems

3.2- Vector and Scalar Quantities

3.3- Some Properties of Vectors

3.4- Components of a Vector and Unit Vectors

Investigative Lab: Riding with the wind (Components of force, acceleration, and velocity)

**Chapter 4 – Motion in Two Dimensions (October)**

4.1- The Position, Velocity, and Acceleration Vectors

4.2- Two-Dimensional Motion with Constant Acceleration

4.3- Projectile Motion

4.4- The Particle in Uniform Circular Motion

4.5- Tangential and Radial Acceleration

4.6- Relative Velocity and Relative Acceleration

Video Analysis Lab: Find instantaneous velocity, acceleration of a tossed ball.

**Chapter 5 – The Laws of Motion (October – November)**

5.1- The Concept of Force

5.2- Newton’s First Law and Inertial Frames

5.3- Mass

5.4- Newton’s Second Law

5.5- The Gravitational Force and Weight

5.6- Newton’s Third Law

5.7- Some Applications of Newton’s Laws

5.8- Forces of Friction

Probeware Lab: When will an object slide?

**Chapter 6 – Circular Motion and Other Applications of Newton’s Laws (November)**

6.1- Newton’s Second Law for a Particle in Uniform Circular Motion

6.2- Non-uniform Circular Motion

6.3- Motion in Accelerated Frames

6.4- Motion in the Presence of Resistive Forces

Forensics Lab: You aren’t going to slide out of this one! (How can a skid mark left on the pavement help police reconstruct the events of an accident?)

**Chapter 7 – Energy of a System (December - January)**

7.1- Systems and Environments

7.2- Work Done by a Constant Force

7.3- The Scalar Product of Two Vectors

7.4- Work Done by a Varying Force

7.5- Kinetic Energy and the Work- Kinetic Energy Theorem

7.6- Potential Energy of a System

7.7- Conservative and Non-conservative Forces

7.8- Relationship Between Conservative Forces and Potential Energy

7.9- Energy Diagrams and Equilibrium of a System

Investigative Labs: Making the grade (Mechanical Energy)

Wrap your energy in a bow (Energy and Work)

**Chapter 8 – Conservation of Energy (January – February)**

8.1- The Non-isolated System: Conservation of Energy

8.2- The Isolated System

8.3- Situations Involving Kinetic Friction

8.4- Changes in Mechanical Energy for Non-conservative Forces

8.5- Power

Investigative Labs: Conserving your energy

Muscle Up! (Power)

**Chapter 9 – Linear Momentum and Collisions (February – March)**

9.1- Linear Momentum and its Conservation

9.2- Impulse and Momentum

9.3- Collisions in One Dimension

9.4- Collisions in Two Dimensions

9.5- The Center of Mass

9.6- Motion of a System of Particles

9.8- Rocket Propulsion

Probeware Lab: Is momentum conserved in a collision?

**Chapter 10 – Rotation of a Rigid Object About a Fixed Axis (March)**

10.1- Angular Position, Velocity, and Acceleration

10.2- Rotational Kinematics: The Rigid Object Under Constant Angular Acceleration

10.3- Angular and Translational Quantities

10.4- Rotational Kinetic Energy

10.5- Calculation of Moments of Inertia

10.6- Torque

10.7- The Rigid Object Under Net Torque

10.8- Energy Considerations in Rotational Motion

10.9- Rolling Motion of a Rigid Object

Forensics Lab: All I need is a little leverage. (Can a person use a simple lever to create thousands of pounds of force?)

**Chapter 11 – Angular Momentum (March – April)**

11.1- The Vector Product and Torque

11.2- Angular Momentum: The Non-isolated System

11.3- Angular Momentum of a Rotating Rigid Object

11.4- The Isolated System: Conservation of Angular Momentum

Investigative Lab: What can set you spinning? (Angular Momentum)

**Chapter 13 – Universal Gravitation (April)**

13.1- Newton’s Law of Universal Gravitation

13.2- Free-fall Acceleration and the Gravitational Force

13.3- Kepler’s Laws and the Motion of Planets

13.4- The Gravitational Field

13.5- Gravitational Potential Energy

13.6- Energy Considerations in Planetary and Satellite Motion

Project: Scale model of the Solar System & Planet Report

**Chapter 15 – Oscillatory Motion (April - May)**

15.1- The Motion of an Object Attached to a Spring

15.2- The Particle in Simple Harmonic Motion

15.3- Energy of the Simple Harmonic Oscillator

15.4- Comparing Simple Harmonic Motion with Uniform Circular Motion

15.5- The Pendulum

15.6- Damped Oscillations

15.7- Forced Oscillations

Investigative Lab: Pendulum Vibrations (investigate the period, frequency, and amplitude of a pendulum.)